

CLAIMS

1. A trocar adapted to provide access for a surgical instrument
5 through a body wall and into a body cavity, comprising:
 - a cannula having a proximal end and a distal end;
 - a seal housing communicating with the cannula to define a working
channel;
 - a seal assembly disposed within the seal housing;
 - 10 at least one roller included in the seal assembly and having an axle
supported by the seal housing; and
 - the roller having properties for forming a zero seal in the absence
of the instrument, and an instrument seal in the presence of the instrument.
2. The trocar recited in Claim 1, wherein the roller is pivotal
with the axle relative to the seal housing.
3. The trocar recited in Claim 1, wherein:
 - the axle has a fixed relationship with the seal housing; and
 - the roller has a pivotal relationship with the axle.

4. The trocar recited in Claim 1 wherein the roller in radial cross-section has the configuration of a geometric shape.

5. The trocar recited in Claim 4, wherein the geometric shape is a circle.

6. The trocar recited in Claim 4, wherein the geometric shape is a star.

7. The trocar recited in Claim 1, wherein the roller is a first roller, the axle is a first axle, and the trocar further comprises:

a second roller disposed on a second axle in sealing engagement with the first roller, the second axle having a general parallel relationship with the first axle.

8. The trocar recited in Claim 7, wherein:

the first roller has the configuration of a first cylinder with a
5 first radius;

the second roller has the configuration of a second cylinder
with a second radius; and

the first axle is separated from the second axle a distance
not greater than the sum of the first radius and the second radius.

9. The trocar recited in Claim 1, wherein the roller is sized and
configured to form the instrument seal with the instrument, the instrument seal
having a diameter with a lower limit of about zero millimeters, and an upper limit
in a range between about six millimeters and 12 millimeters.

10. The trocar recited in Claim 1, further comprising:
a spring for biasing the roller relative to the seal housing.

11. The trocar recited in Claim 1, wherein the roller is a first
roller rotatable on a first axis and the trocar further comprises:
a second roller rotatable on the first axis.

12. The trocar recited in Claim 1, wherein the roller is a first roller rotatable on a first axis and the trocar further comprises at least one second roller rotatable on a second axis different than the first axis.

13. The trocar recited in Claim 12, further comprising:
a least one third roller rotatable on a third axis different than the first axis and the second axis.

14. The trocar recited in Claim 1, wherein the roller comprises a toroid.

15. A surgical combination, comprising:
an instrument having a diameter of at least about one millimeter;
an access device adapted to facilitate disposition of the
5 instrument across a body wall;
a cannula included in the access device and having an axis extending between a proximal end and a distal end;
a seal housing communicating with the cannula, to define a working channel with the cannula;

10 a seal assembly disposed within the seal housing of the
access device;

 a roller included in the seal assembly, the roller being sized
and configured to form a zero seal in the absence of the instrument and an
instrument seal in the presence of the instrument.

16. The surgical combination recited in Claim 15, wherein the
roller includes a gel material.

17. The surgical combination recited in Claim 15, wherein:
 the roller has an axle with two ends;
 at least one of the ends of the axle being supported by the
housing.

18. The surgical combination recited in Claim 15, further
5 comprising:
 an interior wall disposed within the seal housing; and

the roller having properties for forming the zero seal with the interior wall.

19. The surgical combination recited in Claim 17, wherein the roller includes a gel material supported on the axle and rotatable with the axle relative to the seal housing.

20. The surgical combination recited in Claim 17, wherein the axle has a fixed relationship with the seal housing and the gel material is supported on the axle and rotatable relative to the axle.

21. The surgical combination recited in Claim 15, wherein the diameter of the instrument is at least about 5 millimeters.

22. The surgical combination recited in Claim 21, wherein the diameter of the instrument is at least about 10 millimeters.

23. The surgical combination recited in Claim 15, wherein the seal housing and the roller are formed of translucent materials.

24. A trocar assembly, including:

a cannula extending along an axis between a proximal end and a distal end;

a seal housing communicating with the cannula to define a working channel;

a roller disposed within the seal housing, the roller being pivotal on an axis;

a resilient material included in the roller and having properties susceptible to tearing in response to an instrument inserted into the working channel; and

the roller being moveable by the inserted instrument to pivot the resilient material relative to the axis to inhibit tearing of the resilient material.

25. The trocar assembly recited in Claim 24, wherein:
the roller has an end surface and a circumferential surface;
and
an instrument inserted into the working channel encounters
5 a frictional resistance associated with the end surface and a rolling resistance
associated with the circumferential surface.

26. The trocar assembly recited in Claim 24, wherein:
the resilient material defines an outer surface of the roller;
and
the outer surface has properties for wiping an instrument
5 inserted into the working channel.

27. The trocar assembly recited in Claim 25, further comprising:
a washer disposed between the end surface of the roller and
the seal housing.

28. The trocar assembly recited in Claim 27, wherein the washer
includes at least one of polytetrafluoroethylene and a fabric.

29. The trocar assembly recited in Claim 26, wherein portions of the resilient material define at least one circumferential groove around the roller.

30. The trocar assembly recited in Claim 24 wherein the roller is a first roller, the axis is a first axis, and the trocar assembly further comprising:

a second roller disposed within the seal housing and pivotal on the first axis.

31. The trocar assembly of Claim 24, wherein the roller is a first roller, the axis is a first axis, and the trocar assembly further comprises:

a second roller disposed within the seal housing and being pivotal on a second axis different than the first axis.

32. A trocar assembly, comprising:

a cannula having a proximal end and a distal end;

a seal housing communicating with the cannula to define a working channel;

a roller having an outer surface pivotal on an axis and being
5 disposed in proximity to an inner surface of the seal housing; and

at least one wiper disposed between the outer surface of the
roller and the inner surface of the housing.

33. The trocar assembly recited in Claim 32, wherein:

the wiper is carried by the roller and is moveable with the
roller to wipe the inner surface of the housing.

34. The trocar assembly recited in Claim 32, wherein:

the wiper is supported on the seal housing and is disposed
to wipe the outer surface of the roller.

35. The trocar assembly recited in Claim 34, wherein the wiper is a first wiper and the trocar assembly further comprises:

a second wiper supported on the housing and forming with the first wiper a chamber defined by the outer surface of the roller and the inner surface of the housing; and

a substance disposed within the chamber for coating the outer surface of the roller.

36. The trocar assembly recited in Claim 35, wherein the substance is a lubricant.

37. A trocar assembly, comprising:
a cannula having an axis extending between a proximal end and a distal end;

a seal housing communicating with the cannula to define a working channel;

a roller having an axle supported by the seal housing, the roller having properties for forming an instrument seal when an instrument is inserted into the working channel;

a resilient material defining an outer surface of the roller;

and

portions of one of the resilient material and the axle defining at least one void.

38. The trocar assembly recited in Claim 37, wherein portions of the resilient material defines the void to facilitate formation of the instrument seal.

39. The trocar assembly recited in Claim 37, wherein:
portions of the axle define the void to receive an inflow of the resilient material into the void of the axle in order to facilitate a fixed relationship between the resilient material and the axle.

40. The trocar assembly recited in Claim 37, wherein portions of the resilient material define at least one circumferential groove in the roller.

41. A trocar assembly, comprising:

a cannula having a proximal end and a distal end;

a seal housing having an inner surface and being disposed at one of the proximal end and the distal end of the cannula;

5 a roller having a resilient outer surface and an axle for pivoting the outer surface relative to the inner surface of the seal housing; and

portions of the inner surface of the seal housing defining at least one recess configured and arranged to receive the axle.

42. The trocar assembly recited in Claim 41, wherein:

the axle has at least one end with an area in radial cross-section, the size of the recess being generally greater than the area of the axle
5 end.

43. The trocar assembly recited in Claim 42, wherein the recess

has a width, and a length greater than the width, the length being disposed generally in a particular relationship to the working channel to facilitate translation of the roller relative to the working channel.

44. The trocar assembly recited in Claim 43, wherein the particular relationship is generally parallel.

45. The trocar assembly recited in Claim 43, wherein the particular relationship is generally perpendicular.

46. The trocar assembly recited in Claim 43, wherein the particular relationship is an acute angle.

47. A trocar assembly, comprising:

- a cannula having an axis extending between a proximal end and a distal end;
- a valve housing communicating with the cannula to define a working channel;
- a roller valve disposed on an axle in the valve housing and including a compliant material, the valve having properties for forming a zero seal across the working channel in the absence of the instrument, and an instrument seal across the working channel in the presence of the instrument;
- and

the instrument seal having a diameter in radial cross-section ranging from a lower limit of about zero millimeters to an upper limit greater than about 6 millimeters. .

48. The trocar assembly recited in Claim 47, wherein the valve comprises:

first portions forming a wall seal with the valve housing; and
second portions forming the zero seal in the absence of the
5 instrument in the working channel, and the instrument seal in the presence of the
instrument in the working channel.

49. The trocar assembly recited in Claim 48, wherein the valve has properties for moving relative to the valve housing.

50. The trocar assembly recited in Claim 49, wherein the valve has properties for translating relative to the valve housing.

51. The trocar assembly recited in Claim 50 wherein the valve has properties for translating along a path disposed at an acute angle to the working channel.

52. The trocar assembly recited in Claim G49, wherein the valve has properties for pivoting relative to the valve housing.

53. The trocar assembly recited in Claim 52, wherein the valve has properties for rotating relative to the valve housing.

54. The trocar assembly reciting Claim 47, wherein the compliant material includes a gel.

55. The trocar assembly recited in Claim 47, wherein the compliant material of the valve includes an inflatable bladder.

56. A seal assembly adapted to provide access for a surgical instrument across the body wall and into a body cavity, comprising:

a cannula ;

a valve housing defining with the cannula a working channel
5 and having an axis extending between a first end and a second end;
a valve disposed in the valve housing and being movable
within the valve housing between a first position and a second position; and
the valve having first compression characteristics relative to
the instrument at the first position, and second compression characteristics
10 relative to the instrument at the second position.

57. The seal assembly recited in Claim 56, wherein the first
position is in proximity to the proximal end of the valve housing.

58. The seal assembly recited in Claim 56, wherein:
the housing includes a pair of opposing walls; and
the walls between the first position and the second position
diverge toward the second position.

59. The seal assembly recited in Claim 58, wherein the first
compression characteristics are greater than the second compression characteristics.

60. The seal apparatus recited in Claim 56, further comprising:
a low friction surface disposed between the valve and the valve housing.

61. The seal assembly recited in Claim 60, wherein the low-friction surface is formed on a belt moveable relative to the valve housing.

62. The seal assembly recited in Claim 56, wherein at least one of the valve and the valve housing is formed of a translucent material.

63. The seal assembly recited in Claim 62, wherein the valve is formed of a gel material.

64. A valve assembly adapted to receive an elongate object and to form an object seal with the object, the assembly comprising:
a valve housing having a first opening at a first end and a second opening at a second end;

5 a valve disposed in the valve housing and forming a housing seal
with the valve housing; and
the valve having properties for forming a first object seal when the
object is inserted through the first opening at the first end of the valve assembly, and
alternatively forming a second object seal when the object is inserted into the second
10 opening at the second end of the valve housing.

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65. The valve recited in Claim 64, wherein:

the valve housing has an axis extending through the first opening
and the second opening; and
the valve is symmetrical about the axis of the valve assembly.

66. The valve assembly recited in Claim 64, wherein in the absence of
5 an object, the valve has properties for forming a first zero seal to inhibit fluid flow
through the first opening, and alternatively a second zero seal to inhibit fluid flow
through a second opening.

67. A method of sealing a surgical access device, comprising the steps of:

providing a cannula sized and configured for disposition across a body wall and into a body cavity;

5 coupling the cannula to a seal housing to form a working channel;

and

sealing the working channel in the seal housing with a gel material to prevent any fluid flow through the working channel both in the presence of an instrument in the working channel and in the absence of an instrument in the working

10 channel.